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WHICH ADDITIONAL IMPACT CATEGORIES ARE READY FOR UPTAKE IN THE CEN STANDARDS EN 15804 AND EN 15978? EVALUATION FRAMEWORK AND INTERMEDIATE RESULTS

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Abstract

The European standards developed by CEN TC350 for assessing the sustainability of construction works, i.e. EN15804 (construction products) and EN15978 (buildings), consider seven impact categories within the life cycle assessment approach. When looking at commonly used Life Cycle Impact Assessment (LCIA) methods (e.g. IMPACT 2002+ and ReCiPe) and the recently developed Product Environmental Footprint (PEF) of the European Commission, more impact categories are included. Scientific studies indicate the necessity to consider these additional impact categories. The question arises if declaring solely the seven CEN TC350 impact categories is sufficient or if additional impact categories should be taken up. In the context of this potential need for a broader environmental perspective, a new work item proposal within CEN TC350 has been approved for drafting a CEN Technical Report (TR) containing an overview and evaluation of additional impact categories. The goal of the TR is to collect information on six impact categories: human toxicity, ecotoxicity, particulate matter, ionising radiation, land use/biodiversity and water scarcity. The TR can be used as input for further discussions on the need for updating the standards. The draft TR was finalised in January 2016 on the basis of literature study and feedback from experts, amongst others the EC-Joint Research Centre. The process of the development of the TR and the framework for the evaluation of the seven additional impact categories (and potentially others in future) are described. Finally, the main draft conclusions on the impact categories are summarised.

Keywords:
Life cycle assessment; impact categories; European Standards; EN 15804; EN 15978

1 INTRODUCTION

The European standards developed by CEN TC350 for assessing the sustainability of construction works, i.e. EN15804 (construction products) and EN15978 (buildings), consider seven impact categories within the life cycle assessment (LCA) approach. 00 The seven impact categories included are: depletion of abiotic resource elements, depletion of abiotic resource fossil fuels, acidification for soil and water, ozone depletion, global warming, eutrophication and photochemical ozone creation. A more extended list of impact categories is however considered in commonly used Life Cycle Impact Assessment (LCIA) methods (e.g. IMPACT 2002+ and ReCiPe) and the recently developed EC Product Environmental Footprint (PEF). 000 Scientific studies indicate that different design decisions might be taken when a more extended number of impact categories are considered in LCA studies of buildings 0000. The question arises if declaring solely the seven CEN

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TC350 impact categories is sufficient or if additional impact categories should be included in the standards in order to have a more comprehensive insight in the environmental impact of construction products and buildings. In the context of this potential need for a broader environmental perspective, a new work item proposal (NWIP) within CEN TC350 has been approved in November 2014 for drafting a CEN Technical Report (TR) containing an overview and evaluation of several additional impact categories: Work Item 00350023 0. The goal of the TR is twofold, i.e. (1) to develop a framework to evaluate if additional impact categories should be included in the CEN standards EN 15804 and EN 15978, and (2) to collect information on six impact categories: human toxicity, ecotoxicity, particulate matter, ionising radiation, land use/biodiversity and water scarcity (in line with the evaluation framework developed). The TR serves as input for further discussions on the need for updating the previously mentioned standards. The draft TR was finalised in January 2016 on the basis of a literature study, feedback from experts, amongst others the EC-Joint Research Centre, and feedback from the members of Working Group 1 (cf. construction products) and 3 (cf. buildings) of CEN TC 350 (WG1&3). The process of the drafting of the TR and the framework for the evaluation of the six additional impact categories (and potentially others in future) are described. Finally, the main draft conclusions on the impact categories are briefly summarised.

2 METHODS

2.1 Process drafting Technical Report

The TR has been developed based on a multidimensional approach. In a first step and preliminary to the acceptance of the NWIP, a two-day workshop was organized (June 2014) in Brussels to gain insights from LCA experts and experts from the construction sector on the additional impact categories to be analysed. The workshop was attended by about 60 participants representing LCA practitioners, knowledge institutes, standardisation entities, sector federations and the European Commission (DG Environment, DG Growth and DG JRC), whereof 17 experts (i.e. Karen Allacker, Jerome Payet, Morten Birkved, Wim Debacker, Lorenzo Benini, Sebastien Humbert, Assumpció Antón, Mark Goedkoop, Johannes Kreissig, Stephan Pfister, Peter Maydl, Jeroen Guinée, Frank Van Assche, Frank Werner, David Crowhurst, Ralf Lehman, Sylviane Nibel). The participants contributed to the workshop by sharing their perspective on the relevance of the additional impact categories and the scientific robustness of the impact assessment models available to assess the impacts. The information from the workshop was accompanied by an in depth literature review by KU Leuven, VITO and the Belgian Federal Public Service Health, Food Chain Safety and Environment, and a consultation of the EC-JRC experts. This lead to a first draft TR. In order to include stakeholder consultation in the drafting, several WG1&3 meetings have been organised during which the intermediate versions were discussed and improved and based on which the draft TR has evolved to the final draft of January 2016. At several moments written feedback was asked and received by the members of WG1&3.

The final draft version of the TR (January 2016) includes a description of the evaluation framework developed and the evaluation of each of the six additional impact categories. Possibilities for uptake in the standards are included for each impact category in an informative annex. In the subsequent section 2.2 the evaluation framework is described and in section 2.3 the main conclusions from the evaluation are summarised for each impact category evaluated.

2.2 Evaluation framework

The evaluation framework (Fig. 1) is subdivided in two sets of criteria: standardization criteria and scientific/applicability criteria 0 but were slightly changed in order to avoid duplications with the standardisation criteria. The scientific/applicability criteria are further referred to as ILCD criteria. The framework consists of seven steps.

The **first step** evaluates the environmental relevance of the impact category by answering the following questions:

- What is the degree of pertinence of the indicator(s) for the addressed impact category?
- Is it documented clearly what the proposed additional impact category addresses?
- Is the impact category identified as important by the society?
- Is the building sector contributing to the impact category?
- Is it documented whether it is a midpoint or an endpoint indicator or whether it is a resource indicator?

In the **second step** the relevance of the impact category for buildings and construction products is evaluated based on the following questions:

- Could the impact category and related indicator affect the design of a building or building product?
- Is the impact and related indicator specific to the site (i.e. applicable only to the site of the works)?
- Is the impact and related indicator specific to the construction products used in the building, i.e. is it an embodied impact?
- Could the impact category and indicator affect the choice of materials and products incorporated in buildings?

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In the **third step** the policy relevance is evaluated. In respect of legislation, regulation and/or official recommendations, the following question is asked:

- Is the impact category/indicator referred to in any existing/notified national or European legislation?

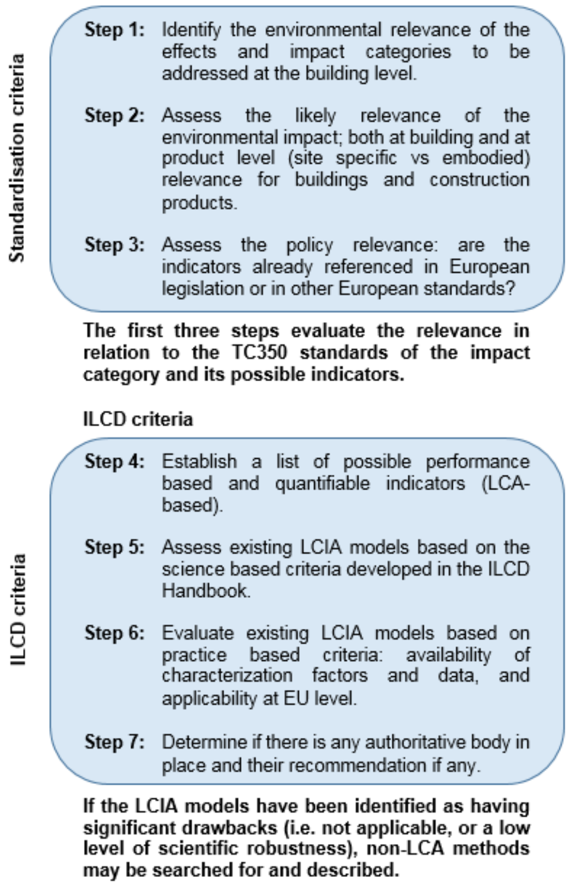

Fig. 1: Evaluation framework for the additional environmental impact categories.

The character of the indicator is evaluated in the **fourth step**. As the CEN standard provides quantified environmental information, a prerequisite for the indicators is that they are quantifiable. Preference is given to LCA indicators rather than to quantifiable non-LCA indicators (e.g. embodied energy and amount of occupied land).

The **fifth step** focuses on the scientific robustness and certainty of the LCIA models and is based on the ILCD handbook criteria. This evaluation step considers the scientific quality of the characterisation models, the completeness of the scope, the quality of the modelling of the cause-effect chain and the transparency and level of reproducibility.

The **sixth step** evaluates the applicability of the LCIA model by considering the following criteria:

- Availability of life cycle inventory (LCI) data and characterisation factors
- Experience: how widely is the model used?
- Availability of the model within existing, widely used LCA tools (within the TR, Simapro (Pre Consultants), GABI (Thinkstep) and openlca (GreenDelta) are considered)

As broad acceptance is important in standardisation, in the **final step** it is determined whether there is an authoritative body behind a model (consensus/international endorsement), and if such an authoritative body has made any recommendations regarding any LCIA model and related indicator.

In summary, for each identified impact category/group of environmental effects identified in step 1 and found relevant in step 2 and/or step 3, a list of possible LCA-based assessment models and related indicators is established (step 4). In step 5 the models and indicators are assessed regarding the science based criteria of the ILCD handbook (see further) and in step 6 the practicability is evaluated. In the final step 7, recommendations of any authoritative body are identified.

3 RESULTS

3.1 Human toxicity

Human toxicity is found to be relevant for the environment and both at building and construction product level. Human toxicity is moreover part of European and international policies. The USEtox model v1.01 is identified as the preferred LCIA model for human toxicity, as it is a consensus model that is updated regularly 0.

The members of the CEN TC 350 WG1&3 identified some issues regarding the scientific robustness and practicality of the USEtox model v1.01. More specific concern exists on the availability and quality of LCI data (both foreground and background). These concerns are mainly identified for the product group metals.

The TR hence concludes that toxicity assessment of construction products and buildings using current methodologies should not be communicated without interpretation due to inherent uncertainties and recommends further improvements on the availability and quality of LCI data. It is however important to note that recently USEtox v.2.0 0 has been released but could not be evaluated in the timeframe of the TR. It is suspected that several of the identified issues regarding scientific robustness and practicality have been resolved in this latest version.

3.2 Ecotoxicity

For freshwater ecotoxicity, identical conclusions are drawn as for human toxicity (see section 3.1). Marine and terrestrial ecotoxicity are found relevant for the environment and both construction

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products and buildings, but the USEtox model v1.01 is found to be insufficiently robust.

3.3 Particulate matter

Particulate matter (PM) is found to be relevant for the environment, and both at the building and product level, and is part of European and international policies.

RiskPoll/Humbert (2009) is identified as the recommended LCIA model 00. It is highlighted that it is difficult to accurately measure total suspended particles (TSP) and different PM fractions, especially for fugitive dust sources or in humid conditions. If to be included in the CEN standards, guidelines for measurement (e.g. Dutch standard, NTA 8029+C1:2012 0) might be an important issue.

3.4 Ionising radiation

The analysis of ionising radiation revealed that it is relevant for the environment. Both at the construction product level and at the building level it is however not clear if ionising radiation is relevant. It is identified as a potentially good indicator to identify nuclear energy use during the life cycle of the building and construction products. It is clarified that ionizing radiation exposure of a person is mainly caused by exposure to natural sources; direct exposure from the ground is sometimes high and is influenced by location and the design of the building. Ionising radiation is part of European, international and national policies and is widely regulated in EU member states.

For human health, the LCIA model of Frischknecht et al. 0 and for ecosystem health, the LCIA model of Garnier-Laplace et al. 0 substantially meet the evaluation criteria in the framework.

3.5 Impacts related to land use / biodiversity

The land use interventions evaluated in the TR cover both land transformation and land occupation. The impact of these interventions on biodiversity, soil quality and ecosystem functions is evaluated. The impact on land as resource is not evaluated as no explicit statistical or other data is found.

It is concluded that land use related to buildings (in situ and embodied land use) and construction products (embodied land use) cause relevant environmental impacts. If land use is to be included, it would be important to include it in a comprehensive way in order to understand the burdens that arise. No single indicator is currently available which cover the several impacts identified. The EC-JRC is developing such single land use indicators (expected September 2016).

From the currently available LCIA models, the following are identified as the most preferred. For the impact on biodiversity, the LCIA model for land use within ReCiPe (based on Köllner, 2001 0) is identified as the best available method to assess biodiversity losses. It however neglects land transformation to and from mineral extraction sites and urban areas. Eco-Indicator 99 0, on the other hand, includes land transformation impacts and takes into account land transformation processes related to mineral extraction and the urban built area. This method however is based on old data with a geographically limited scope and needs to be updated. For the impact on soil quality, the LCIA model of Mila I Canals et al. 0 (Soil Organic Matter) seems to substantially meet the evaluation criteria in the framework. Although this method has been updated (new data and a better global coverage) by Brandao and Milà i Canals, 2013 0, the updated method is currently not available in the common LCA software and hence fails the practicality criterion. Regarding ecosystem functions, the only available LCIA model is the LANCA model which does not meet the evaluation criteria in the framework.

3.6 Water scarcity

Water scarcity is found to be relevant for the environment, and both at building and at product level. Water scarcity is part of European, international and national policies.

It is concluded that impact category water scarcity better represents the environmental impact associated with water use than the current measure of net freshwater use included in the EN 15804 and EN 15978.

Regarding the choice of indicator, for both human health and quality of ecosystems, the WULCA recommended method – AWaRe – substantially meets the evaluation criteria of the framework 0. However, it has not been widely applied yet.

4 CONCLUSIONS

A draft version of the CEN technical report on additional environmental impact categories has been finalised in January 2016. The main outcomes of this TR are presented in this paper. The TR reveals that many of the additional impact categories analysed are relevant for the environment, for construction products and buildings and have a policy relevance. For many of the additional impact categories sufficiently robust LCIA models are available, however sometimes with some issues to be taken care of. The TR will be an important document for discussing the uptake of additional impact categories in the current standards EN 15804 and EN 15978.

5 ACKNOWLEDGMENTS

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